CLAIMS

1. A method for use with an automatic transmission having an off-going clutch and an on-coming clutch during a speed ratio shift event, the method comprising:

controlling the off-going clutch using closed loop control to maintain a predetermined slip threshold, said controlling the off-going clutch including generating an off-going clutch pressure command to which the off-going clutch is responsive and that varies with respect to time;

causing the on-coming clutch to gain torque capacity during said controlling the off-going clutch;

determining the first derivative with respect to time of at least a portion of the off-going clutch pressure command; and

determining when the on-coming clutch gained torque capacity using the first derivative.

2. The method of claim 1, wherein said determining when the on-coming clutch gained torque capacity includes using a neural network method.

3. The method of claim 2, wherein said first derivative is characterized by local minima and maxima, and wherein said determining when the on-coming clutch gained torque capacity includes generating a set of data points, each of the data points including a time value and a first derivative value of one of the local minima or maxima.

4. The method of claim 3, further comprising

classifying each of the data points into one of a first group and a second group using a k-means algorithm, the data points in the second group having later time values than the data points in the first group; and

determining the data point having the earliest time value in the second group.

5. The method of claim 4, wherein the on-coming clutch includes an apply chamber, wherein the on-coming clutch is hydraulically actuated by filling the apply chamber with fluid, wherein said causing the on-coming clutch to gain torque capacity includes supplying fluid to the apply chamber, and wherein the method further includes determining a measure of the total volume of fluid supplied to the apply chamber at the time value of the data point having the earliest time value in the second group.

6. A control apparatus for an automatic transmission having an input shaft and an output shaft; a first clutch and a second clutch; a first and second fill chamber to which hydraulic fluid is supplied for hydraulic actuation of the first and second clutch, respectively; a first and second actuator configured to selectively allow pressurized fluid into the first and second fill chamber, respectively; wherein the first clutch and the second clutch are operatively connected between the input shaft and the output shaft to effect a speed ratio change during a shift event by disengagement of the first clutch and engagement of the second clutch, the control apparatus comprising:

a controller operatively connected to the first actuator and the second actuator to cause selective disengagement and engagement of the first and second clutches, respectively;

wherein the controller is programmed and configured to determine the speed ratio between the input shaft and the output shaft in order to determine the existence of a predetermined slip threshold at the first clutch;

wherein the controller is programmed and configured to control the off-going clutch during the shift event using closed loop control to maintain the predetermined slip threshold by generating an off-going clutch pressure command to which the first clutch is responsive and that varies with respect to time;

wherein the controller is programmed and configured to cause the on-coming clutch to gain torque capacity during the shift event;

wherein the controller is programmed and configured to determine the first derivative with respect to time of at least a portion of the off-going clutch pressure command; and

wherein the controller is programmed and configured to determine when the on-coming clutch gained torque capacity using the first derivative.

7. The control apparatus of claim 6, wherein the controller is programmed and configured to employ a neural network method to determine when the on-coming clutch gained torque capacity using the first derivative.

8. The control apparatus of claim 7, wherein said first derivative is characterized by local minima and maxima, and wherein the controller is programmed and configured to generate a set of data points, each of the data points including a time value and a first derivative value of one of the local minima or maxima.

9. The control apparatus of claim 8, wherein the controller is programmed and configured to classify each of the data points into one of a first group and a second group using a k-means algorithm, the data points in the second group having later time values than the data points in the first group, and wherein the controller is programmed and configured to determine the data point having the earliest time value in the second group.

10. The control apparatus of claim 9, wherein the controller is programmed and configured to determine a measure of the total volume of fluid supplied to the apply chamber at the data point having the earliest time value in the second group .

11. A method for use with an automatic transmission having an off-going clutch and an on-coming clutch during a speed ratio shift event, the on-coming clutch being characterized by hydraulic actuation when an apply chamber is filled with sufficiently pressurized fluid, the method comprising:

controlling the off-going clutch using closed loop control to maintain a predetermined slip threshold, said controlling the off-going clutch including generating an off-going clutch pressure command to which the off-going clutch is responsive and that varies with respect to time;

causing the on-coming clutch to gain torque capacity by supplying fluid to the apply chamber during said controlling the off-going clutch;

determining the first derivative with respect to time of at least a portion of the off-going clutch pressure command, said first derivative being characterized by local minima and maxima;

generating a set of data points, each of the data points including a time value and a first derivative value of one of the local minima or maxima;

classifying each of the data points into one of a first group and a second group using a k-means algorithm, the data points in the second group having later time values than the data points in the first group;

determining the data point having the earliest time value in the second group; and

determining a measure of the total volume of fluid supplied to the apply chamber at the data point having the earliest time value in the second group.